THE SPECIAL ... OFFICE ...
2 JAN ...

Hyderabad Archæological Series

No. 17

STUDY OF AN ANCIENT FABRIC AND ITS IDENTIFICATION

By

S. S. GHOSH

Forest Research Institute, Dehra Dun

TNSDA
00520

GOVERNMENT OF HYDERABAD
सत्यमेव जयते

Published by
THE DIRECTOR OF ARCHAEOLOGY
GOVERNMENT OF HYDERABAD

KRISHNAVAS INTERNATIONAL
PRINTERS, HYDERABAD-DECCAN

1953

29.1

730.1

OFFICE OF THE SPECIAL OFFICER FOR ARCHAEOLOGY
520
2 JAN 1967

Study of an ancient fabric and its identification

By

S. S. GHOSH

Forest Research Institute, Debra Dun

Preface

The tiny specimen of ancient textile studied in this monograph, which was found in close association with punch-marked silver coins, comes from Habbal village (Taluqa Gulbarga) in the Gulbarga District of Hyderabad State. Its very small size baffled all attempts at a scientific analysis: but this difficulty was soon overcome by devising a new technique — explained at length in the text of the monograph. For this my special thanks are due to Dr. K. A. Choudhury of the Forest Research Institute, Dehra Dun. I am also grateful to Dr. B. B. Lal, Archæological Chemist to Government of India, but for whose ready help and co-operation this brochure would never have seen the light of day.

This study has established beyond doubt that textile industry had reached a high degree of development at the time these punch-marked coins were in vogue in this part of India. A separate monograph on these and other punch-marked coins found in the Hyderabad State is under preparation by this department.

HYDERABAD - DECCAN
May 12, 1953

P. SREENIVASACHAR
Director

Study of an ancient fabric and its identification

By

S. S. GHOSH

Forest Research Institute, Dehra Dun

Introduction

A fragment from an ancient fabric was sent by Dr. B. B. Lal, Archaeological Chemist, Dehra Dun, to the Forest Research Institute for identification of the raw material that was originally used in its preparation. The material sent was so small that at first it appeared doubtful whether its examination would lead to any fruitful results. Generally speaking, determination of fibres usually requires a fairly large quantity of material so that their different aspects, such as (a) physical characteristics (b) micro-chemical tests (c) ultimate cell features and (d) anatomical structure of cross section can be studied. With this material it was not possible to carry out all the tests. However, according to the suggestion of Dr. K. A. Chowdhury, Wood Technologist, Forest Research Institute, Dehra Dun, an attempt was made to develop some new technique which ultimately led to its identification.

Material and methods

Material: The material for investigation was hardly 3 mm. in length. It was somewhat greenish in colour and fairly hard. When examined with a hand lens, a twisted pattern of somewhat coarse texture was evident. After cutting with a pair of fine scissors, the exposed surface looked like a bunch of fibre and the colour inside was somewhat whitish. The fibre appeared to be very closely twisted and could not be easily teased and separated with a needle.

Methods: A preliminary treatment with toluene was given to remove any varnish that might have been applied to it. The material was then kept in dilute hydrochloric acid till most of the extraneous material was dissolved away. After a thorough washing in water, it was treated with dilute Eau de Javalle with a view to removing all traces of foreign matter. Final cleaning was made under water with a pair of fine camel hair brushes. At this stage the material appeared to be fairly soft and somewhat lustrous.

The specimen was then divided into two portions: one for cutting cross sections and the other for maceration. The former was dehydrated slowy in various grades of alcohol and transferred to xylol and finally embedded in paraffin. Cross sections of about 12 microns thickness were cut and fixed on the slides with Haupt's fixative. They were stained first with haematoxylin and then one lot with saffranin and the other, Bismark brown.

The sample for maceration was kept in 1% solution of chromic acid in an electric oven at 40° C. From time to time, it was examined under the microscope and the treatment was stopped as soon as the fibres separated out easily. They were then washed and mounted.

RESULTS

Anatomical structure in cross section

Under a low power microscope the material appears to be a portion of some bark containing groups of fibres along with cortical cells (Fig. 2). However, under a high power microscope considerable detailed structure can be seen. The fibres are closely held together in groups or bundles but *not arranged in radial rows* (Figs. 2, 3). They are usually round to oval in shape. Majority of fibres show deterioration and it is not possible to determine their diameter except in a few cases. The diameter varies from 11 microns to 39 microns. The lumen is mostly indistinct (Figs. 2, 3). The fibre walls are fairly thick and occasionally the secondary and tertiary layers are distinct, and may come off from the primary layer. As a rule, the primary layer takes deep stain and appears to be fairly thick (Fig. 3). Stratified or lamellated nature of the fibre wall is occasionally distinct. (Fig. 3, s). Parenchyma cells are present and often contain dark deposit (Fig. 5).

Anatomical structure of ultimate fibres obtained by maceration

Entire fibres are not available for measurement. The incomplete fibres are more than 2 mm. (2200 microns) in length (Fig. 6). They are cylindrical or tubular without any twist. Ends of fibres, when noticed, are usually blunt or not sharp (Fig 7). At right angles to the fibre axis there are some transverse markings or striations. The lumen (central canal) is usually indistinct. No vascular tissues or epidermal cells have been detected in the macerated material.

Discussion and identification

Vegetable fibres may be classified under three categories :—

1. Seed hairs or other surface fibres e.g. cotton, kapok and others, which are either characterised by a natural twist, ribbon–like form, isolated nature of cross sections (cotton) or by tapering cylindrical form with distinct basal ends (kapok[1, 2, 3]).

---

1. Some applications of Microscopy to Cotton Research by Baily and Rollins. Textile Research, Vol. XV, No. 1, 1945.
2. Application of Microscopy of the Textile Industry. 1947.
3. Textile Fibres under the microscope. I. C. I. Ltd., London.

2. Leaf fibres obtained from monocotyledonous plants e.g. plantain, palm and others where the fibres occur in thick strands accompanied by abundant vascular tissue.[1, 2]

3. Bast fibres obtained from the bark of broad-leaved plants (dicotyledonous) e.g. flax, hemp, sunn hemp, jute, and others, usually occuring in small to large bundles but not accompanied by vascular tissue.

It will be seen that the material under investigation comes under the third category which includes many fibres of commercial importance. Amongst these fibres, jute (*Corchorus* spp.)[3, 4], brown hemp (*Hibiscus cannabinus*), roselle (*Hibiscus sabdariffa*), ban bhindi (*Malacra capitata*) and cuba jute (*Sida rhombifolia*), etc., show considerable anatomical difference from the unknown. The arrangement and shape of the fibres and fibre bundles are so different that the unknown material under investigation cannot be any of the fibres mentioned above.[5]

The fibres that now remain to be compared with are flax (*Linum usitatissimum*), hemp (*Cannabis sativa*), sunn hemp (*Corotalaria juncea*) and rhea or ramie, china grass (*Boehmeria* spp.) and most of these are very important textile fibres of both modern as well as ancient times.[6] Among these, the ramie fibres[7] can be discarded on account of their very wide diameters (upto 80 microns). The remaining fibres e.g., flax, hemp and sunn hemp show similarity to the unknown fibre in many respects. For further careful scrutiny, it is absolutely necessary to compare in detail the most salient features of these fibres, and this has been done in Table I.

1. Technology of paper making fibres by Harrar and Lodewick, 1934.
2. An Atlas of paper making fibres by C. A. Carpenter. *Tech. Pub.* No. 35, New York State Coll. For., Syracuse Univ., 1931.
3. Anatomical studies of Jute (*Corchorus*) with special reference to the formation of fibre by Ghosh, Rao and Patel. *Agric. Res. Mem.* No. 1, 1944.
4. Anatomy of retted Jute by Patel and Ghosh. *Agric. Res. Mem.* No. 2, 1944.
5. Textile Fibres by Mathews. 4th Edition. 1942.
6. Some aspects of Indian Civilization by G. P. Mazumdar, 1938.
7. Textile fibres—an engineering approach to their properties and utilization by H. Smith 1944.

[*Statement*

TABLE I (1, 2, 3)

Microscopic characters of flax, sunn hemp and the unknown.

Characters	Flax	Sunn hemp	Hemp	Ancient fibre
1. Length of ultimate fibres (cells)	4-66 mm.	4-12 mm.	5-55 mm.	Incomplete fibres more than 2 mm.
2. Diameter of fibres (cross section)	15 to 37 microns	25 to 50 microns	16 to 50 microns	11 to 39 microns
3. Cell shape	polygonal with sharp edges	oval or crescent shaped	not polygonal, cells with rounded edges	not polygonal, round to oval
4. Cell lumen	narrow or reduced to a point, hence very distinct longitudinally	wide, often with yellow matter	narrow to wide, always empty and not distinct longitudinally	narrow to wide, not distinct longitudinally
5. Intercellular layer	inconspicuous	very thick	thick and deeply stained	thick and deeply stained
6. Cell grouping (fibre bundles)	single or in small groups	large groups	small to large groups	small to large groups
7. Fibre ends	sharply pointed	blunt and thickened	blunt, sometimes forked	blunt ?
8. Dislocations or joints on fibres	always present and abundant	present but not abundant	not always present, occasionally observed locally	not present
9. Transverse markings or striations on fibres	present but mostly intersecting or crossing each other diagonally forming a characteristic cross "X"	present but not abundant, often forming a cross	abundant but mostly parallel and rarely intersecting diagonally to form a cross	abundant and parallel, cross markings absent
10. Parenchyma cells round the fibres	absent	absent	present	present

1. Textile fibres by Mathews. 4th Edition, 1942.
2. The structure of Economic plants by Hayward, 1938.
3. Introduction to the Botany of Field Crops, Vol. II, by Hector, 1936.

It will be noticed from the above table that flax, sunn hemp and hemp have points of similarity, more or less, with the ancient fibre. But a closer scrutiny will reveal that essential diagnostic features of flax such as the polygonal shape of the fibres, distinct lumen, and conspicuous dislocations and cross markings on the fibre walls are totally lacking in the ancient fibre. Again, important characteristics of sunn hemp e. g., very thick walled intercellular (primary) layer and wide lumen containing yellow matters are not present in the material under investigation. Neither the dislocations and cross-markings on the fibre walls can be found in the unknown. Furthermore, both flax and sunn hemp do not have adhering parenchyma cells which appear to be characteristic of the unknown. The only material that now remains to be compared is hemp. In this case it will be seen that in all anatomical details such as cell shape, cell groupings, indistinct cell lumen, and deeply stained intercellular layer, ancient fibre resemble hemp most. Morever, the presence of peculiar transverse markings on the fibre walls, and the persistence of parenchyma cells round the fibre bundles are of great diagnostic value for hemp fibres (1). Both these characters are to be found in the unknown. It would, therefore, be seen that the ancient fabric is made of hemp fibres.

ACKNOWLEDGEMENT

Grateful acknowledgement is due to Dr. K. A. Chowdhury, D. Sc., F. N. I., for his criticism and suggestions. My thanks are also due to Mr. K. Ramesh Rao, M. A., B. Sc., for his help throughout the progress of the work.

EXPLANATION OF PHOTOMICROGRAPHS

Fig. 1. Transverse section of ancient fabric showing a fibre bundle (f. b.). Note the shape and size of the individual fibres (f). X 150.

Fig. 2. Transverse section showing another fibre bundle (f. b.) along with cortical cells (c.c.). Note that the lumen (1) is mostly indistinct and majority of fibres show deterioration (d.f.). X 200.

Fig. 3. Transverse section of the fibres under high magnification. Note in one cell on the left the stratified nature of the fibre wall (s), and lumen (1) in another cell on the right. Deeply stained intercellular layer (i) and deteriorated nature of fibres (d. f.) are distinct. X 300.

Fig. 4. Another view of a transverse section showing two fibre bundles (f. b.). X 150.

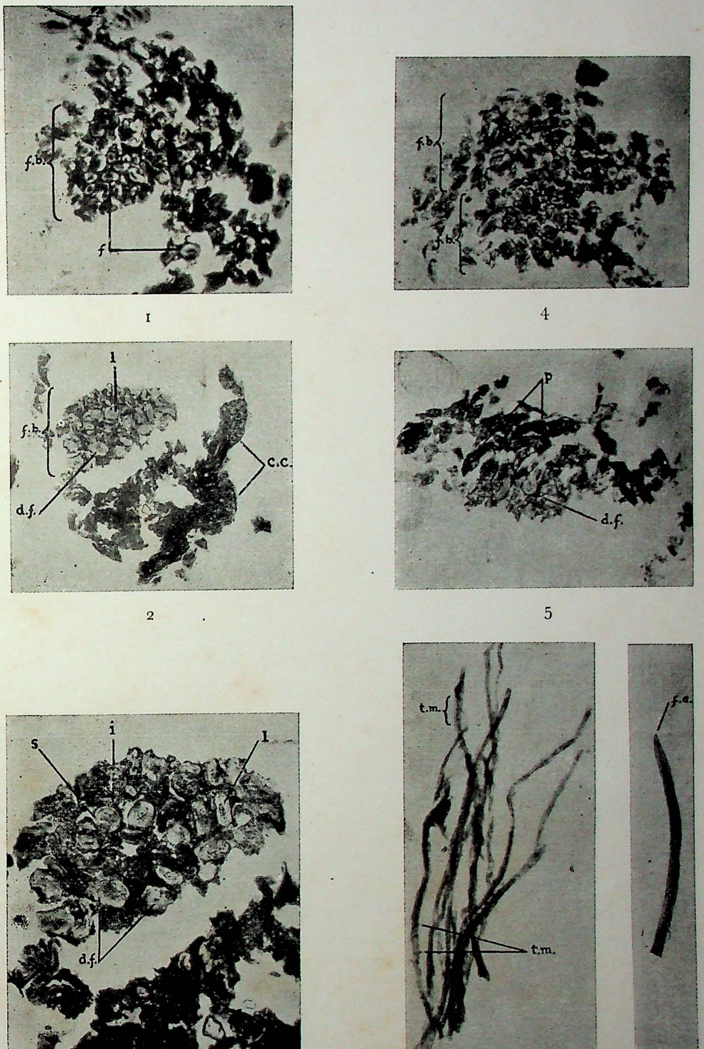
Fig. 5. Transvers section showing a group of parenchyma cells (p) adhering to the deteriorated fibres (d. f.). Note dark deposits in the parenchyma cells. X 110.

---

1. Textile fibres by Mathews, 4th Ed. 1942.

Fig. 6. Group of altimate fibres obtained after maceration. Note that the fibres are incomplete but many transverse markings (t.m.), characteristic of hemp fibres, are distinct. X 70.

Fig. 7. Part of an ultimate fibre showing the end portion of a fibre. Note the blunt nature of the fibre end (f. e.) X 150.



Anatomical structure of fibres of the ancient fabric